Rattlesnake Creek dam removal

FUTURE FISHERIES IMPROVEMENT PROGRAM GRANT APPLICATION

Please fill in the highlighted areas

all sections (IA, IB, IC, etc.) must be addressed or the application will be considered invalid

I. APPLICANT INFORMATION

A. Applicant Name: Trout Unlimited

B. Mailing Address: 312 N Higgins Ave, Suite 200

C. City: Missoula State: MT Zip: 59802

Telephone: 406-540-2944 E-mail: rroberts@tu.org

D. Contact Person: Rob Roberts

Address if different from Applicant:

City: State: Zip:

Telephone: E-mail:

E. Landowner and/or Lessee Name (if other than Applicant): City of Missoula

Mailing Address: 435 Ryman Street

City: Missoula State: MT Zip: 59802

Telephone: 406-552-6000 E-mail: MValliant@ci.missoula.mt.us

II. PROJECT INFORMATION*

A. Project Name: Rattlesnake Dam Removal Project

River, stream, or lake: Rattlesnake Creek

Location: Township: 13N Range: 19 Section: 02

Latitude: 46.9149500 Longitude: -113.9633333 *within project (decimal degrees)*

County: Missoula

B. Purpose of Project:

Demolition of dam and associated infrastructure and restoration of Rattlesnake Creek

C. Brief Project Description:

Rattlesnake Creek dam removal

Rattlesnake Creek is an 82 square-mile drainage that originates in the Rattlesnake Wilderness and joins the Clark Fork River in downtown Missoula, Montana. The watershed is designated as Bull Trout Critical Habitat, and the stream supports a robust trout community consisting of both native and wild trout populations. The Rattlesnake Creek corridor is a recreation hub for residents and visitors, with a large network of mountain bike and hiking trails. Further, the confluence of Rattlesnake Creek and the Clark Fork was historically one of the largest and most important fish camps for the native Salish people.

Rattlesnake Creek Dam was constructed in 1901 to be the primary water source for Missoula by impounding more than 3 million gallons of water in an adjacent constructed reservoir. In the early 1980s, Rattlesnake Creek water became contaminated with giardia because of beaver populations in the middle reaches, which led to giardia outbreaks in the city's water system. As a result, in 1983 the Mountain Water Company stopped using the Rattlesnake Watershed system as the primary water supply, transferred to groundwater wells and began maintaining it as the city's backup supply.

Since that time the Dam has served no water storage or delivery purpose (and is no longer even viable as a back-up municipal system), but has continued to deteriorate and impact fish migrations and river processes (e.g. floodplain connections, sediment transport). Although construction of a fish ladder at the site in 2003 helped to mitigate fish passage impacts, recent structural modifications at the dam have compromised benefits to some species (including bull trout). With the recent purchase of the water system, dam and associated infrastructure by the City of Missoula (in June 2017), there is a unique – and immediate – opportunity to decommission the obsolete municipal water system and remove the dam.

Montana Fish, Wildlife and Parks biologists believe that removal of the dam and associated infrastructure is the best long term, comprehensive option for enhancing fish populations and restoring natural stream function in the drainage. Further, they have stated that the current project is the most important stream enhancement project in the Missoula area. The City of Missoula, Trout Unlimited and Montana FWP are invested in restoring habitat for native fish and terrestrial wildlife, improving water quality in Rattlesnake Creek, improving public safety and providing additional scenic open space and recreational opportunities for the community. Therefore, the City, MFWP and TU are working collaboratively to implement a restoration project at the dam that will remove existing man-made infrastructure and fully re-naturalize the site.

The proposed project plan will remove all infrastructure on the dam site, including the dam spillway, reservoir retaining wall, the entire earthen embankment, screen houses, utilities, and cabins/outbuildings. Post dam removal stream restoration will begin approximately 300 feet upstream of the reservoir intake and tie in 200 feet downstream of the dam on City property, for a total of approximately 2,000 feet of stream channel reconstruction and bank treatments. The reservoir will require approximately 14,000 cubic yards of fill material to raise the surface elevation to floodplain level. The constructed channel will meander into the floodplain located east of the existing channel. The channel profile will be gradually raised to improve floodplain connection in the stream corridor and have a slope of 1.3 percent. The historic channel and reservoir will be filled with excavated fill material and converted to off-channel habitat features, including side channels, alcoves, large wood, boulder clusters and wetlands. As a result, the restoration of Rattlesnake Creek will be possible on a footprint similar to reference valley widths. The channel and floodplain restoration will utilize the full valley width of approximately 270 feet. A more complete list of streambed, streambank, floodplain and vegetation treatments and photos are provided as an attachment to this document.

TU and partners have already spent $150,000 on Phase I planning, data collection and design activities. This proposal requests partial funding of Phase II of this project for dam demolition and restoration activities. TU has secured nearly $700,000 in matching funds for Phase II project costs. The project is expected to be completed during the field seasons of 2019 and 2020.

D. Length of stream or size of lake that will be treated: 2,000 feet

E. Project Budget:

Grant Request (Dollars): $ 50,000

Contribution by Applicant (Dollars): $ 55,029.00 In-kind $

(salaries of government employees are not considered as matching contributions)

Contribution from other Sources (Dollars): $ 800,000 In-kind $

(attach verification - See page 2 budget template)

Total Project Cost: $ 905,029.00

F. Attach itemized (line item) budget – see template

G. Attach **specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support and fish biologist support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete a *supplemental questionnaire*** (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

H. **Attach land management & maintenance plans that will ensure protection of the reclaimed area**.

III. PROJECT BENEFITS*

A. What species of fish will benefit from this project?:

Bull Trout, Westslope Cutthroat Trout, Mountain Whitefish

B. How will the project protect or enhance wild fish habitat?:

The project will enhance wild fish habitat by removing the last remaining migration barrier on Rattlesnake Creek and restoring approximately 2,000 feet of the stream channel.

C. Will the project improve fish populations and/or fishing? To what extent?:

Rattlesnake Creek provides the primary spawning and rearing habitat for trout comprising the Clark Fork River fishery in the Missoula area. It also supports the only viable tributary bull trout population in the area.

D. Will the project increase public fishing opportunity for wild fish and, if so, how?:

Rattlesnake Creek is currently open to fishing from the dam downstream to the mouth with the Clark Fork River and closed for six miles upstream of the dam. Following the dam removal project, Montana FWP has discussed reviewing and possibly amending the fishing closure upstream of the dam.

E. The project agreement includes a 20-year maintenance commitment. Please discuss your ability to meet this commitment.

The project site and the surrounding 40 acres will be under the permanent management of the City of Missoula's Parks and Recreation Department after the dam removal project. Following restoration of the site the land will be managed as City Open Space in conjunction with the greater Rattlesnake Greenbelt system of Conservation Lands.

F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?:

The Rattlesnake Creek Dam was originally constructed in 1901 with an earthen embankment and a wood spillway structure for municipal water use, inadvertently forming a complete barrier to upstream fish migration until 2003, when a fish ladder was installed at the site. Since 1983, the dam and associated water infrastructure has been inoperable and non-essential and recent studies have determined that the concrete (orginally placed in 1924) is showing major signs of deterioration and may be prone to failure.

G. What public benefits will be realized from this project?:

Public benefits for the project include the following:

- Restore stream, floodplain and hillslope processes to approximate reference conditions.
- Enhance aquatic habitat by improving passage and habitat conditions that support all life stages of native fish and aquatic organisms.
- Preserve and conserve water quality and quantity by removing a non-functional Dam (elimination of failure risk), reconnection of the stream channel to the floodplain (high flow dispersion and groundwater recharge) and protection of publicly-owned water rights on Rattlesnake Creek
- Develop future use of the site for public recreation in the project design and construction process, and where possible, incorporate design elements to help balance recreation with habitat conservation goals.
- Eliminate the City's costs of operation and maintenance of infrastructure at the Dam, reservoir and intake structure, and minimize the long-term maintenance costs necessary to manage the site as public open space.
- Improve public safety by elimination of hazards and/or potential liability hazards of the existing infrastructure.

H. Will the project interfere with water or property rights of adjacent landowners? (explain):

There is one irrigation diversion upstream of the project site and one irrigation diversion below. Neither will be affected by the project. The dam site includes approximately 50 cfs of instream water rights on Rattlesnake Creek that are now owned and managed by the City of Missoula. The water rights are being reviewed for possible changes to benefit fish and wildlife.

I. Will the project result in the development of commercial recreational use on the site?: (explain):

No

J. Is this project associated with the reclamation of past mining activity?:

No

Each approved project applicant must enter into a written agreement with Montana Fish, Wildlife & Parks specifying terms and duration of the project. The applicant must obtain all applicable permits prior to project construction. A competitive bid process must be followed when using State funds.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature:  Date: 11/27/2018

Sponsor (if applicable):

***Highlighted boxes will automatically expand.**

Mail To: Montana Fish, Wildlife & Parks
Fisheries Division
PO Box 200701
Helena, MT 59620-0701

E-mail To: Michelle McGree
mmcgree@mt.gov
(electronic submissions MUST be signed)

Incomplete or late applications will be rejected and returned to applicant.
Applications may be rejected if this form is modified.

*****Applications must be signed and *received* by the Future Fisheries Program Officer in Helena *before* December 1 and June 1 of each year to be considered for the subsequent funding period**.***

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Rattlesnake Creek dam removal

WORK ITEMS (ITEMIZE BY CATEGORY)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	CONTRIBUTIONS			
					FUTURE FISHERIES REQUEST	IN-KIND SERVICES**	IN-KIND CASH	TOTAL
Personnel* **								
Survey	1	Lump Sum	$5,000.00	$ 5,000.00			$ 5,000.00	$ 5,000.00
Final Design	1	Lump Sum	$35,000.00	$ 35,000.00	5,000.00		$ 30,000.00	$ 35,000.00
Engineering	1	Lump Sum	$15,000.00	$ 15,000.00			$ 15,000.00	$ 15,000.00
Permitting	1	Lump Sum	$20,000.00	$ 20,000.00			$ 20,000.00	$ 20,000.00
Revision	1	Lump Sum	$30,000.00	$ 30,000.00			$ 30,000.00	$ 30,000.00
Oversight	1	Lump Sum	$45,000.00	$ 45,000.00			$ 45,000.00	$ 45,000.00
			Sub-Total	$ 150,000.00	$ 5,000.00	$ -	$ 145,000.00	$ 150,000.00
Travel								
Mileage				$ -				$ -
Per diem				$ -				$ -
			Sub-Total	$ -	$ -	$ -	$ -	$ -
Construction Materials** **								
Boulder Salvage	500	Each	$10.00	$ 5,000.00			$ 5,000.00	$ 5,000.00
Cobble/Gravel Screening	7500	Cubic Yards	$5.00	$ 37,500.00			$ 37,500.00	$ 37,500.00
Wood Acquisition	1	Lump Sum	$25,000.00	$ 25,000.00			$ 25,000.00	$ 25,000.00
Woody Plant Purchase	987	Each	$6.00	$ 5,922.00			$ 5,922.00	$ 5,922.00
Herbaceous Plant Purchase	700	Each	$1.00	$ 700.00			$ 700.00	$ 700.00
Willow Cuttings	10,000	Each	$1.00	$ 10,000.00		10,000.00		$ 10,000.00
Seed	3.5	Acres	$1,000.00	$ 3,500.00			$ 3,500.00	$ 3,500.00
Wire Mesh Fence	3100	Linear Feet	$8.00	$ 24,800.00			$ 24,800.00	$ 24,800.00
Plastic Mesh Fence	1550	Linear Feet	$6.00	$ 9,300.00			$ 9,300.00	$ 9,300.00
			Sub-Total	$ 121,722.00	$ -	$ 10,000.00	$ 111,722.00	$ 121,722.00
Equipment and Labor								
Site Preparation	1	Lump Sum	$30,000.00	$ 30,000.00			$ 30,000.00	$ 30,000.00
Earthwork and Grading	19520	Cubic Yards	$5.00	$ 97,600.00			$ 97,600.00	$ 97,600.00
Spillway Removal	360	Cubic Yards	$75.00	$ 27,000.00			$ 27,000.00	$ 27,000.00
Abutment Wall Removal	450	Cubic Yards	$75.00	$ 33,750.00			$ 33,750.00	$ 33,750.00
Screen House Removal	480	Square Feet	$30.00	$ 14,400.00			$ 14,400.00	$ 14,400.00
Reservoir Wall Removal	1040	Cubic Yards	$75.00	$ 78,000.00			$ 78,000.00	$ 78,000.00
Intake Removal	1	Lump Sum	$10,000.00	$ 10,000.00			$ 10,000.00	$ 10,000.00
Utility Removal	1400	Linear Feet	$10.00	$ 14,000.00			$ 14,000.00	$ 14,000.00
Fish Ladder Removal/Salvage	1	Lump Sum	$5,000.00	$ 5,000.00	5,000.00		$ -	$ 5,000.00
Cabin Removal	1	Lump Sum	$21,000.00	$ 21,000.00			$ 21,000.00	$ 21,000.00

(Revised 11/28/2018)

Concrete Removal	220	Cubic Yards	$75.00	$ 16,500.00			$ 16,500.00	$ 16,500.00
Water and Septic Removal	1	Lump Sum	$1,500.00	$ 1,500.00			$ 1,500.00	$ 1,500.00
Chlorine House Removal	650	Square Feet	$10.00	$ 6,500.00			$ 6,500.00	$ 6,500.00
Water Main Removal	210	Linear Feet	$10.00	$ 2,100.00			$ 2,100.00	$ 2,100.00
Generator House Removal	760	Square Feet	$10.00	$ 7,600.00			$ 7,600.00	$ 7,600.00
Propan Tank Salvage	1	Lump Sum	$2,000.00	$ 2,000.00			$ 2,000.00	$ 2,000.00
Asphalt Removal	1	Lump Sum	$30,000.00	$ 30,000.00			$ 30,000.00	$ 30,000.00
Streambed Construction	2044	Cubic Yards	$8.00	$ 16,352.00			$ 16,352.00	$ 16,352.00
Logjam Construction	4	Each	$2,000.00	$ 8,000.00			$ 8,000.00	$ 8,000.00
Bank Construction	1000	Linear Feet	$30.00	$ 30,000.00	30,000.00		$ -	$ 30,000.00
Floodplain Restoration	4	Acres	$2,000.00	$ 8,000.00			$ 8,000.00	$ 8,000.00
Woody Plant Installation	987	Each	$15.00	$ 14,805.00			$ 14,805.00	$ 14,805.00
Herb. Plant Installation	700	Each	$1.00	$ 700.00			$ 700.00	$ 700.00
			Sub-Total	$ 474,807.00	$ 35,000.00	$ -	$ 439,807.00	$ 474,807.00
Mobilization								
Mobilization	1	Lump Sum	$60,000.00	$ 60,000.00	10,000.00		$ 50,000.00	$ 60,000.00
Contingency (15%)	1	Lump Sum	$98,500.00	$ 98,500.00			$ 98,500.00	$ 98,500.00
			Sub-Total	$ 158,500.00	$ 10,000.00	$ -	$ 148,500.00	$ 158,500.00
			TOTALS	$ 905,029.00	$ 50,000.00	$ 10,000.00	$ 845,029.00	$ 905,029.00

OTHER REQUIREMENTS:

All of the columns in the budget table and the matching contribution table MUST be completed appropriately or the application will be invalid. Please see the example budget sheet for additional clarification.

*Units = feet, hours, inches, etc. Do not use lump sum unless there is no other way to describe the costs.

**Can include in-kind materials. Justification for in-kind labor (e.g. hourly rates used for calculations). Describe here or in text.

Reminder: Government salaries cannot be used as in-kind match

***The Review Panel suggests that design and oversight costs associated with a proposed project not exceed 15% of the total project budget. If design and oversight costs are in excess of 15%, applications must include a minimum of two competitive bids for the cost of undertaking the project.

****The Review Panel recommends a maximum fencing cost of $1.50 per foot. Additional costs may be the responsibility of the applicant and/or partners.

MATCHING CONTRIBUTIONS (do not include requested funds)

CONTRIBUTOR	IN-KIND SERVICE	IN-KIND CASH	TOTAL	Secured? (Y/N)

Trout Unlimited	$ -	$ 55,029.00	$ 55,029.00	Yes
Westslope Chater Trout Unlimited	$ 10,000.00	$ 30,000.00	$ 40,000.00	Yes
Missoula Conservation District	$ -	$ 50,000.00	$ 50,000.00	Yes
Conservation Alliance	$ -	$ 35,000.00	$ 35,000.00	Yes
Patagonia	$ -	$ 25,000.00	$ 25,000.00	Yes
City of Missoula	$ -	$ 75,000.00	$ 75,000.00	Yes
Hewlett Foundation	$ -	$ 300,000.00	$ 300,000.00	Yes
MT DNRC	$ -	$ 125,000.00	$ 125,000.00	No
Western Native Trout Initiative	$ -	$ 50,000.00	$ 50,000.00	No
US Fish and Wildlife Service	$ -	$ 50,000.00	$ 50,000.00	No
Northwestern Energy	$ -	$ 50,000.00	$ 50,000.00	No
TOTALS	$ 10,000.00	$ 845,029.00	$ 855,029.00	

Region 2 Headquarters
3201 Spurgin Road
Missoula, MT 59804
Phone 406-542-5506
November 9, 2018

RE: Support Letter
Trout Unlimited, City of Missoula, and FWP Proposal
Rattlesnake Dam Removal and Site Restoration

Dear Committee Members:

This letter in written in support of funding requests for remediation work planned at the Rattlesnake Dam site in Missoula. This facility was previously owned by a private water company (Mountain Water Co.) until the recent purchase by the City of Missoula, which transferred all facilities and water rights to public ownership. The Rattlesnake Dam site was originally constructed and modified to supply water (and power) to Missoula. However, this site has not been used for public water supply or any significant public service for more than 40 years and these facilities are no longer needed.

The Rattlesnake Dam has significantly impact fisheries and stream function on Rattlesnake Creek since its construction nearly a century ago. Rattlesnake Creek provides the primary spawning and rearing habitat for trout comprising the Clark Fork River fishery in the Missoula area. It also supports the only viable tributary bull trout population in the area. Unfortunately, the dam and associated infrastructure still significantly impede trout spawning migrations and limit seasonal movement for several other fish species.

For more than a decade, Montana Fish, Wildlife & Parks (MFWP) and partners have attempted to mitigate fisheries impacts at Rattlesnake Dam through research projects, manual fish passage and construction of a fish ladder. As these projects have been implemented, some impacts to fish migration have been mitigated. However, it has become obvious that removal of the dam and associate infrastructure is the best long term, comprehensive option for enhancing fish populations and restoring natural stream function in this drainage. To date, more than $300,000 has already been spent in attempts to reduce fisheries impacts at the site.

The current project proposed by Montana Trout Unlimited, Missoula Water and MFWP in the stream reach containing Rattlesnake Dam and Reservoir is the most important stream enhancement project in the Missoula area. The project has overwhelming public support from a broad range of interest groups in western Montana (see summary of comments in public scoping) and also includes the potential to dedicate nearly 50 cfs of water rights to instream flow for the benefit of aquatic life. Please join these groups and local public agencies in their efforts to restore this reach of Rattlesnake Creek and restore all of the natural benefits it can provide.

Please don't hesitate to contact me if you would like more information about the project or the associated natural resources in the Rattlesnake watershed.

Sincerely,

W. Ladd Knotek
Fisheries Management Biologist

Rattlesnake Creek Dam – Existing Conditions

Dam, Spillway and Control Buildings

Upstream of Dam and Reservoir

Dam embankment and buildings

Reservoir during water drawdown

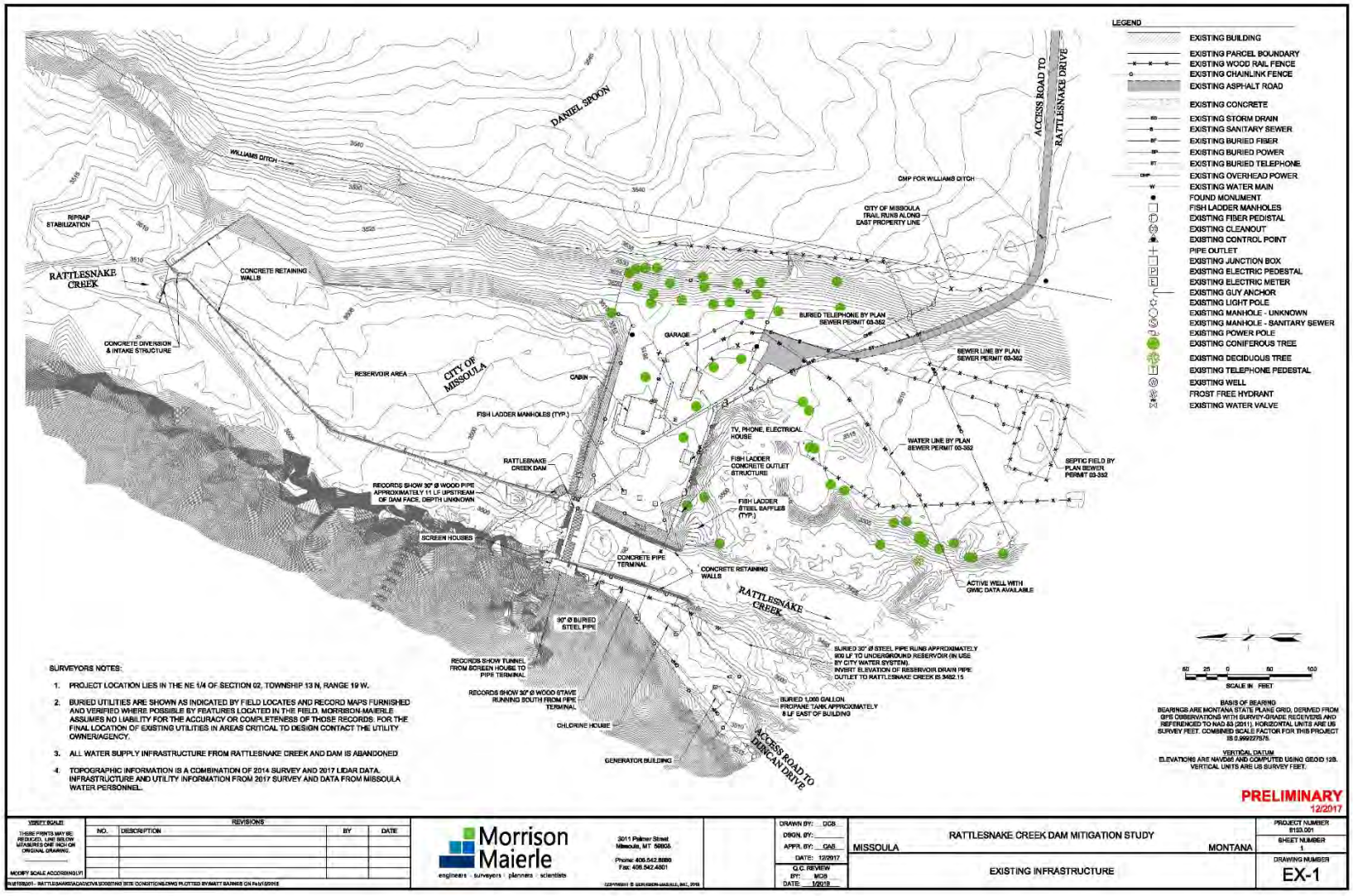
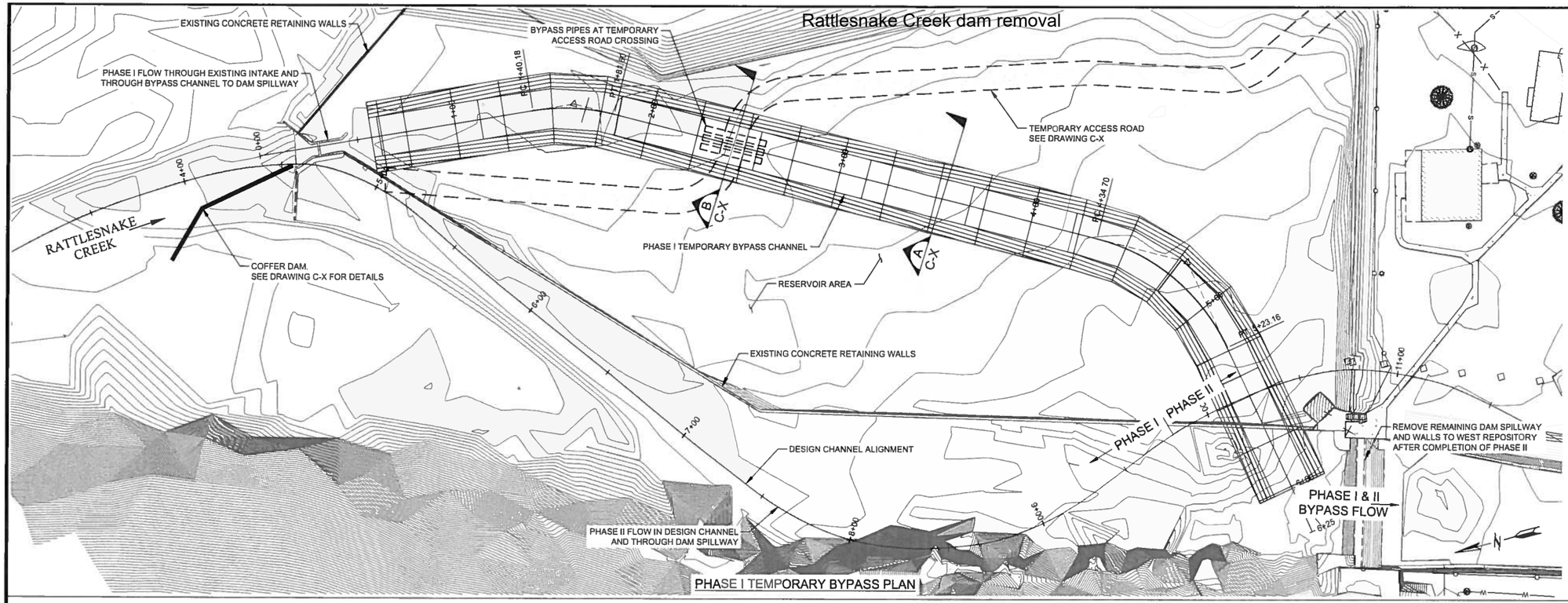


Figure B-1. Rattlesnake Creek Dam Facility. No action Alternative 1.

Rattlesnake Creek dam removal

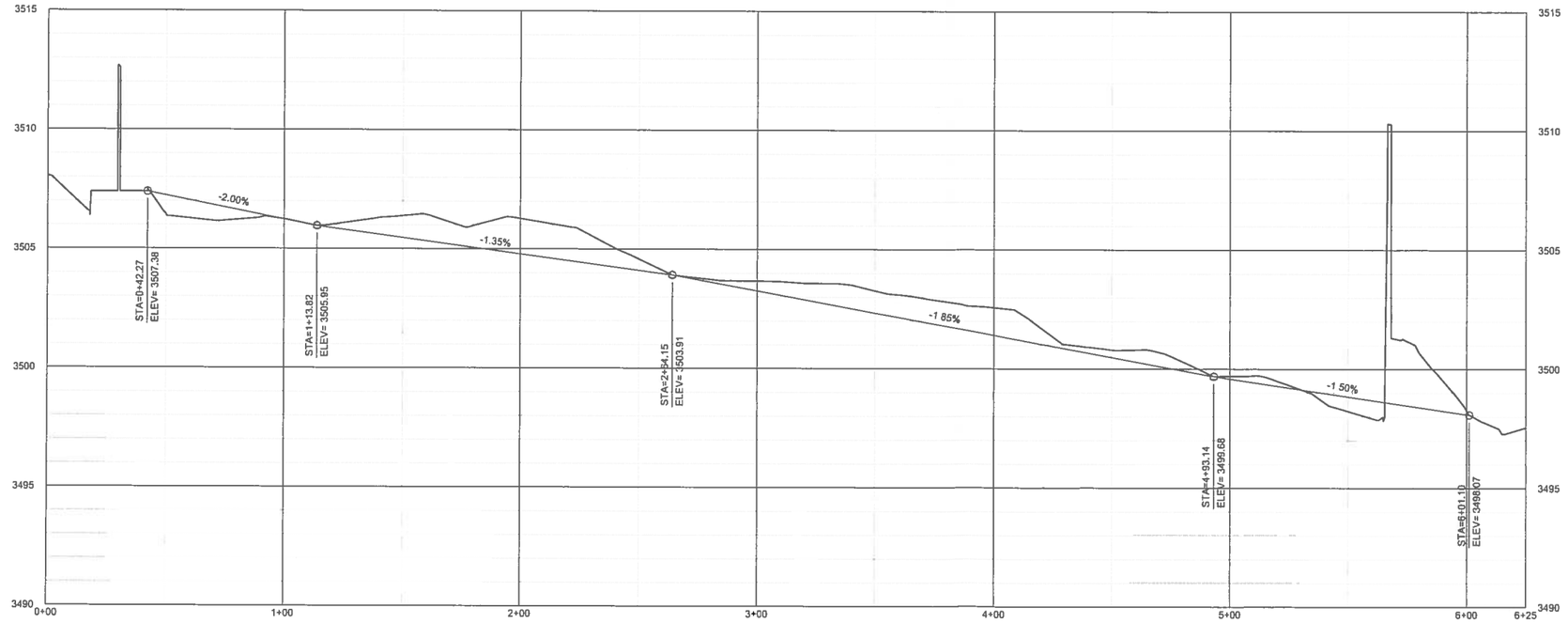


GENERAL NOTES

1. GENERAL NOTE 1.
2. GENERAL NOTE 2.
3. GENERAL NOTE 3.

HORIZ. SCALE IN FEET: 30 15 0 30 60

VERT. SCALE IN FEET: 3 1.5 0 3 6



PHASE I TEMORARY BYPASS PROFILE

PRELIMINARY
NOT FOR CONSTRUCTION

VERIFY SCALE!

THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.

MODIFY SCALE ACCORDINGLY!

REVISIONS			
NO.	DESCRIPTION	BY	DATE

R:\6133\001 - RATTLESNAKE\ACAD\SHEETS\13-RIVER ACCESS & TEMP DIVERSION PLAN & PROFILE PHASE.DWG PLOTTED BY DAVID A. HALLSTEN ON Oct/25/2018

RDG RIVER DESIGN GROUP — Morrison Maierle
engineers • surveyors • planners • scientists

DRAWN BY: DAH
DSGN. BY: LDC
APPR. BY: MDB
DATE: 10/2018
Q.C. REVIEW BY:
DATE:

RATTLESNAKE DAM REMOVAL
MISSOULA MONTANA
RIVER ACCESS AND TEMPORARY DIVERSION PLAN AND PROFILE PHASE I

PROJECT NUMBER 6133.001
SHEET NUMBER X
DRAWING NUMBER C-X

RATTLESNAKE CREEK
CONCRETE RETAINING WALLS
SEE DETAIL A
TEMPORARY ACCESS ROAD SEE DRAWING X-X
WILLIAMS DITCH
DANIEL SPOON
CITY OF MISSOULA TRAIL RUNS ALONG EAST PROPERTY LINE
ACCESS ROAD TO RATTLESNAKE DRIVE
GARAGE TO BE REMOVED BY OTHERS
CABIN TO BE REMOVED BY OTHERS
RESERVOIR AREA
EAST REPOSITORY SEE DRAWING D-2
ABANDON SEPTIC FIELD IN-PLACE
ABANDON WELL IN-PLACE
SALVAGE FISH LADDER BAFFLES
CITY OF MISSOULA
DAM AND SPILLWAY SEE DETAIL B
RATTLESNAKE CREEK
REMOVE POWERLINE TO CABIN
CHLORINE HOUSE
GENERATOR BUILDING
EXISTING ACCESS ROAD
WEST REPOSITORY SEE DRAWING D-2
ACCESS ROAD TO DUNCAN DRIVE

REMOVAL LEGEND

- TO BE BURIED IN EAST REPOSITORY
- TO BE BURIED IN WEST REPOSITORY
- TO BE REMOVED BY OTHERS
- ABANDON IN-PLACE
- SALVAGE
- UTILITY REMOVAL
- FENCE REMOVAL

DIVERSION & INTAKE REMOVAL (A)
SCALE: NTS

SPILLWAY & EMBANKMENT REMOVAL (B)
SCALE: NTS

N

60 30 0 60 120
SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

VERIFY SCALE!
THESE PRINTS MAY BE REDUCED. LINE BELOW MEASURES ONE INCH ON ORIGINAL DRAWING.
MODIFY SCALE ACCORDINGLY!

REVISIONS			
NO.	DESCRIPTION	BY	DATE

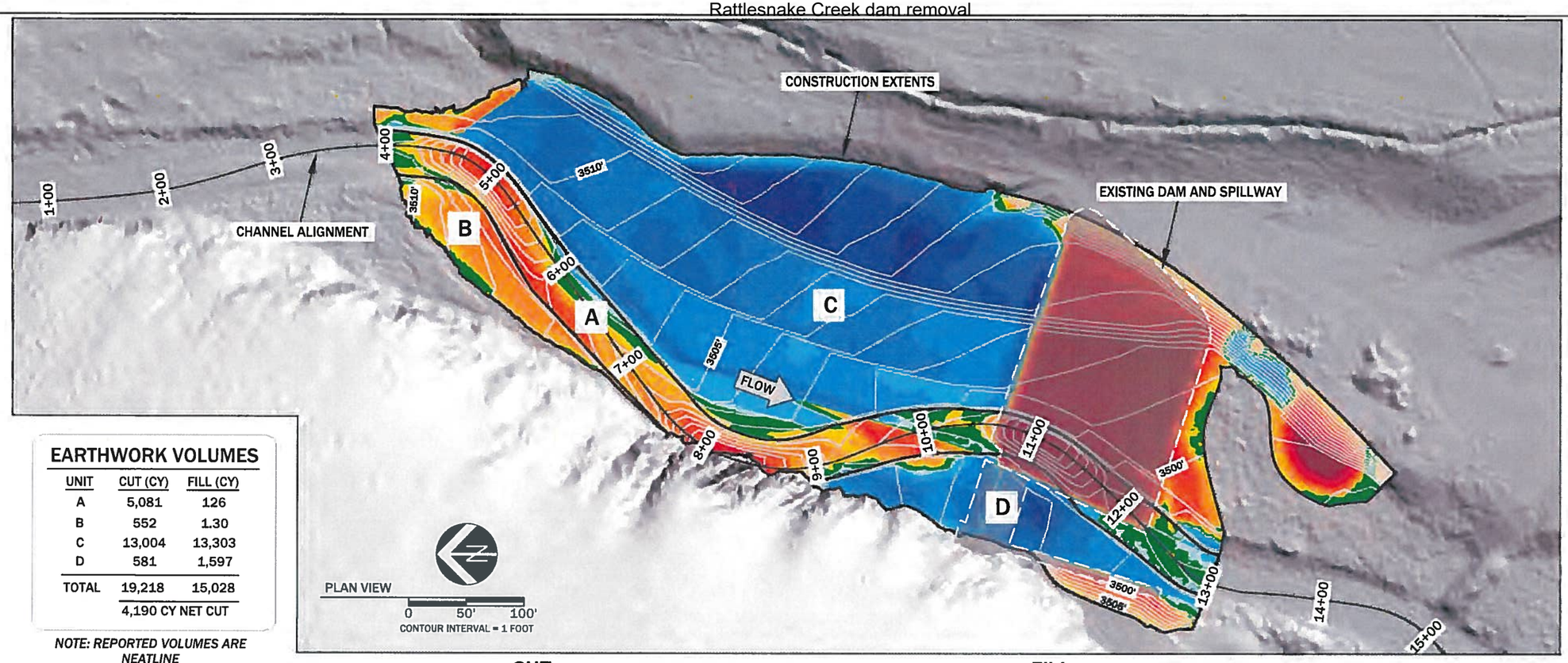
R:\6133\001 - RATTLESNAKE\CAD\SHEETS\17-DEMOLITION PLAN.DWG PLOTTED BY DAVID A. HALLSTEN ON Oct/24/2018

RDG RIVER DESIGN GROUP
Morrison Maierle
engineers • surveyors • planners • scientists

DRAWN BY: DAH
DSGN. BY: MDB
APPR. BY: MDB
DATE: 10/2018
Q.C. REVIEW BY:
DATE:

RATTLESNAKE DAM REMOVAL
MISSOULA MONTANA
DEMOLITION PLAN

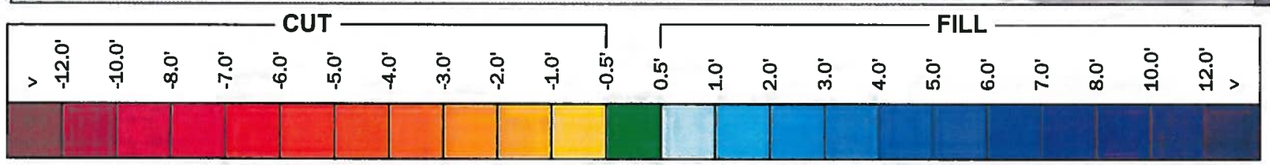
PROJECT NUMBER 6133.001
SHEET NUMBER X
DRAWING NUMBER D-1

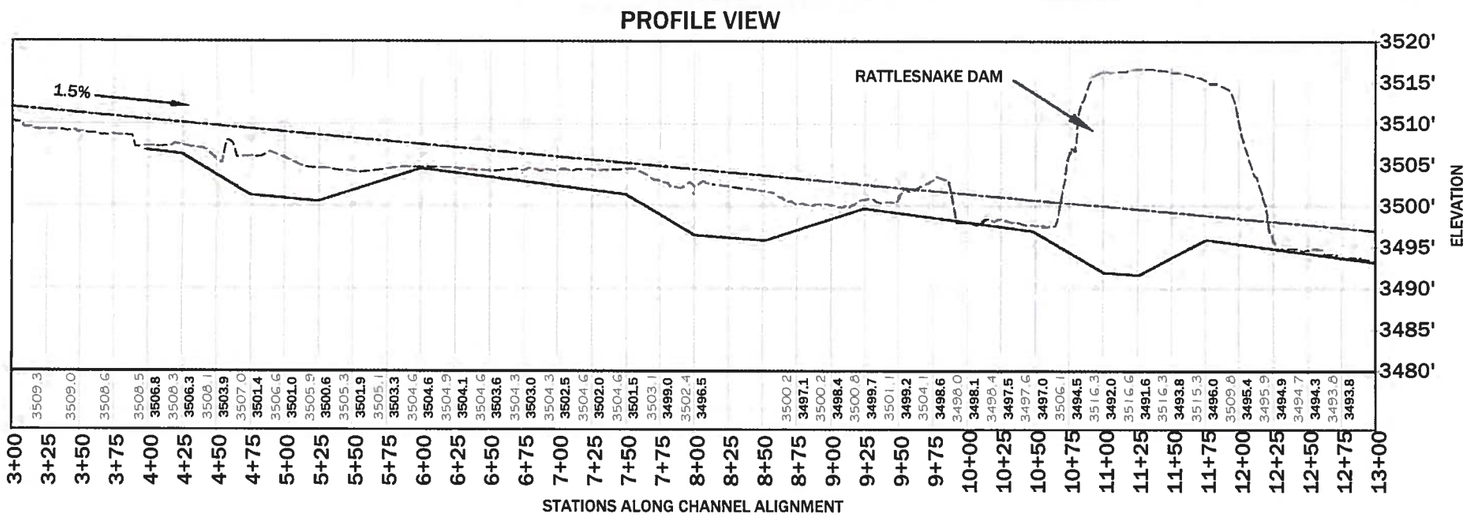


EARTHWORK VOLUMES

UNIT	CUT (CY)	FILL (CY)
A	5,081	126
B	552	1.30
C	13,004	13,303
D	581	1,597
TOTAL	19,218	15,028
	4,190 CY NET CUT	

NOTE: REPORTED VOLUMES ARE NEATLINE





LEGEND

- DESIGN THALWEG
- DESIGN BANKFULL
- EXISTING GROUND - 2017 LIDAR & BATHYMETRY

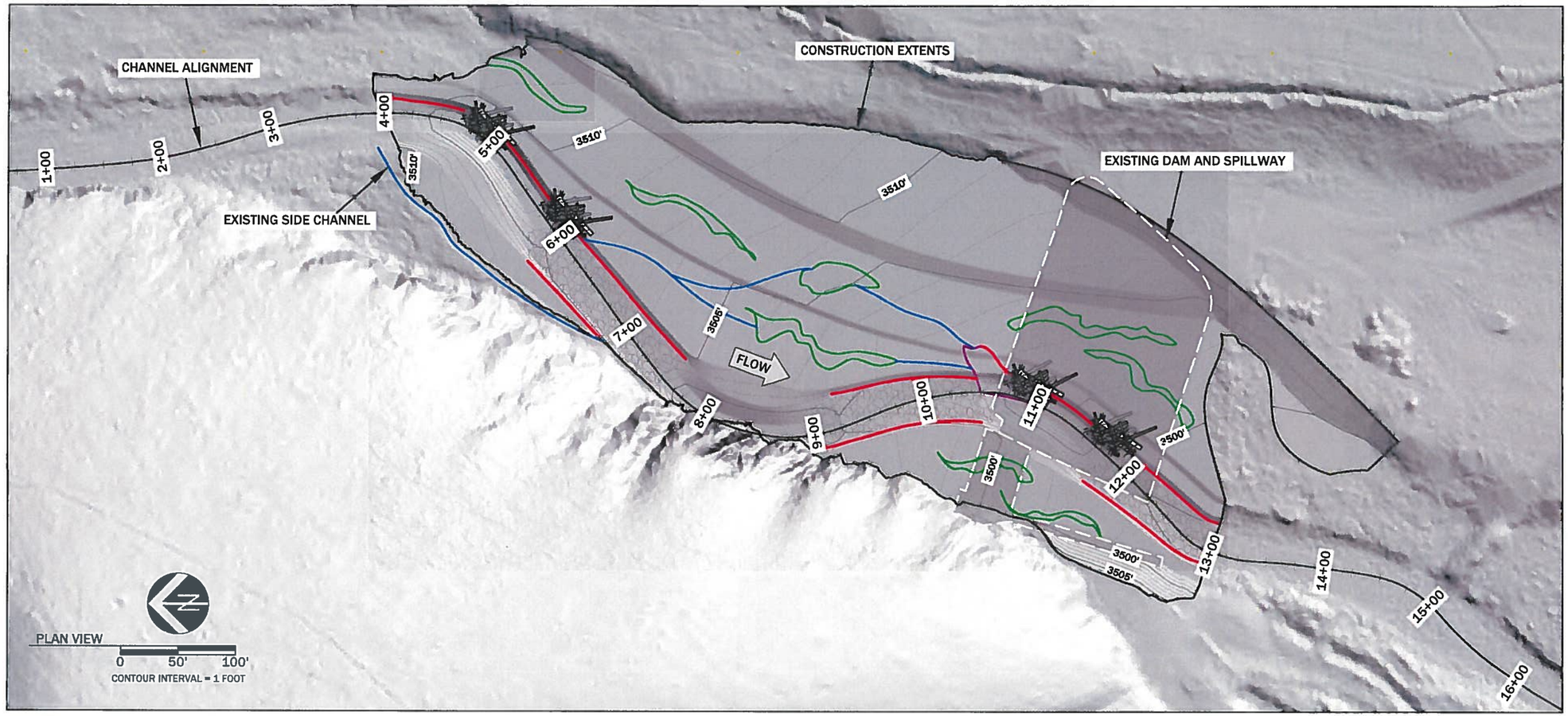
RDG RIVER DESIGN GROUP
311 SW Jefferson Avenue
Corvallis, OR 97333
tel: 541.738.2920
fax: 541.758.8524
5098 Hwy 93 South
Whitefish, MT 59937
tel: 406.862.4927
fax: 406.862.4963

GRADING PLAN AND PROFILE

NO.	DATE	BY	DESCRIPTION	CHK

PROJECT NUMBER
RDG-18-065

SHEET NUMBER



CHANNEL TOP OF BANK ELEVATIONS

STATION	ELEVATION (FT)
1+00	3515.00
1+50	3514.25
2+25	3513.13
4+25	3510.13
4+75	3509.38
5+25	3508.63
6+00	3507.50
7+50	3505.25
8+00	3504.50
8+50	3503.75
9+25	3502.63
10+50	3500.75
11+00	3500.00
11+25	3499.63
11+75	3498.88
13+00	3497.00

STRUCTURE SCHEDULE

STATION START	STATION END	BANK	STRUCTURE
4+00	4+75	L	BRUSH BANK
4+75	5+00	L	LWD
5+00	5+75	L	BRUSH BANK
5+75	6+00	L	LWD
6+00	7+50	L	BRUSH BANK
6+00	7+00	R	BRUSH BANK
6+00	7+50	C	CONSTRUCTED RIFFLE
9+00	10+50	R	BRUSH BANK
9+00	10+50	C	CONSTRUCTED RIFFLE
9+25	10+50	L	BRUSH BANK
10+50	11+00	L	ALCOVE
10+50	10+75	L	BRUSH BANK
10+75	11+00	L	LWD
11+00	11+50	L	BRUSH BANK
11+50	11+75	L	LWD
11+75	13+00	L	BRUSH BANK
11+75	13+00	R	BRUSH BANK
11+75	13+00	C	CONSTRUCTED RIFFLE

LARGE WOOD STRUCTURE (LWD) - REFER TO SHEET x
BRUSH BANK - REFER TO SHEET x
CONSTRUCTED RIFFLE - REFER TO SHEET x

LEGEND

- LARGE WOOD STRUCTURE
- CONSTRUCTED RIFFLE
- BRUSH BANK
- SIDE CHANNEL
- ALCOVE
- CONSTRUCTED WETLAND

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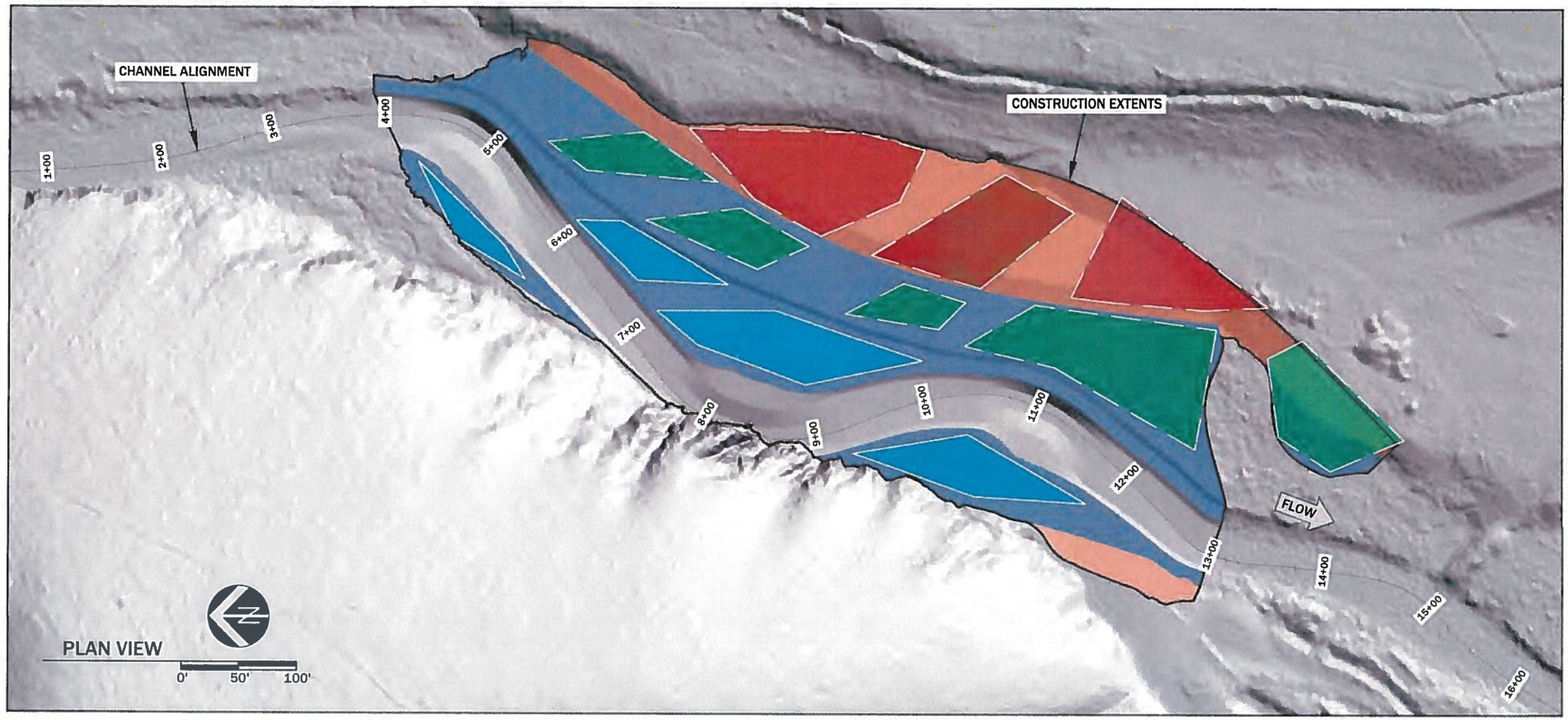
PLAN VIEW AND STRUCTURE LAYOUT

NO.	DATE	BY	DESCRIPTION	CHK

PROJECT NUMBER
RDG-18-065

SHEET NUMBER



LEGEND

FLOODPLAIN TERRACE AND UPLAND EXCLOSURE FENCING

BANKFULL FLOODPLAIN EXCLOSURE FENCING

PLANTING ZONES

UPLAND

FLOODPLAIN TERRACE

BANKFULL FLOODPLAIN

SEEDING ZONES

UPLAND

FLOODPLAIN

PLANTING DETAILS - REFER TO SHEET X
FENCING DETAILS - REFER TO SHEET X

PLANTING AND SEEDING PLAN

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NO.	DATE	BY	DESCRIPTION	CHK

PROJECT NUMBER
RDG-16-065

SHEET NUMBER

PLANTING

LOCATION	SPECIES (TALL 1-GALLON CONTAINERS)		FORM	% CANOPY COMPOSITION	SPACING (FT)	NUMBER
BANKFULL FLOODPLAIN 0.41 ACRES PLANTED WITHIN EXCLOSURES	WATER BIRCH	*BETULA OCCIDENTALIS*	TREE	10	10	18
	RED OSIER DOGWOOD	*CORNUS SERICEA*	SHRUB	35	8	98
	NORTHERN BLACK CURRANT	*RIBES HUDSONIANUM*	SHRUB	25	10	45
	THIMBLEBERRY	*RUBUS PARVIFLORUS*	SHRUB	30	6	149
					TOTAL	309
FLOODPLAIN TERRACE 0.68 ACRES PLANTED WITHIN EXCLOSURES	WATER BIRCH	*BETULA OCCIDENTALIS*	TREE	20	15	26
	SERVICEBERRY	*AMELANCHIER ALNIFOLIA*	TREE	15	15	20
	RED OSIER DOGWOOD	*CORNUS SERICEA*	SHRUB	15	6	123
	CREAMBUSH OCEANSPRAY	*HOLODISCUS DISCOLOR*	SHRUB	5	8	23
	MALLOW LEAF NINEBARK	*PHYSOCARPUS MALVACEUS*	SHRUB	5	8	23
	ROCKY MOUNTAIN MAPLE	*ACER GLABRUM*	SHRUB	20	8	93
	PRICKLY CURRANT	*RIBES LACUSTRE*	SHRUB	5	6	41
	THIMBLEBERRY	*RUBUS PARVIFLORUS*	SHRUB	15	6	123
					TOTAL	349
UPLAND 0.64 ACRES PLANTED WITHIN EXCLOSURES	CHOKECHERRY	*PRUNUS VIRGINIANA*	TREE	10	15	13
	DOUGLAS-FIR	*PSEUDOTSUGA MENZIESII*	TREE	10	15	13
	PONDEROSA PINE	*PINUS PONDEROSA*	TREE	15	15	20
	BLUE ELDERBERRY	*SAMBUCUS NIGRA SSP. CAERULEA*	TREE	5	10	15
	LEWIS' MOCK ORANGE	*PHILADELPHUS LEWISII*	SHRUB	20	10	59
	CREAMBUSH OCEANSPRAY	*HOLODISCUS DISCOLOR*	SHRUB	15	8	69
	MALLOW LEAF NINEBARK	*PHYSOCARPUS MALVACEUS*	SHRUB	10	8	46
	COMMON SNOWBERRY	*SYMPHORICARPOS ALBUS*	SHRUB	20	8	93
					TOTAL	328
					TOTAL WOODY PLANTS	987
CONSTRUCTED WETLAND 0.15 ACRES	ARROWLEAF GROUNDSEL	*SENECIO TRIANGULARIS*	HERB	VARIES	~ 3	700
					TOTAL HERBACEOUS PLANTS	700

SEEDING

LOCATION	SPECIES		PLS/ACRE	TOTAL PLS LBS
FLOODPLAIN 2.02 ACRES	AMERICAN SLOUGHGRASS	*BECKMANNIA SYZIGACHNE*	15.36	31.43
	BLUEBUNCH WHEATGRASS	*PSEUDOROEGNERIA SPICATA*	6.13	12.54
	BLUEJOINT REEDGRASS	*CALAMAGROSTIS CANADENSIS*	0.68	1.39
	SLENDER WHEATGRASS	*ELYMUS TRACHYCAULUS*	6.13	12.54
			TOTAL	57.90
UPLAND: 1.28 ACRES	THICKSPIKE WHEATGRASS	*ELYMUS MACROURUS*	0.68	1.39
	BLUEBUNCH WHEATGRASS	*PSEUDOROEGNERIA SPICATA*	6.26	8.01
	STREAMBANK WHEATGRASS	*ELYMUS LANCEOLATUS*	6.26	8.01
	BLUE WILDRYE	*ELYMUS GLAUCUS*	4.35	5.57
			TOTAL	22.99

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PLANTING AND SEEDING SCHEDULE

NO.	DATE	BY	DESCRIPTION	CHK

PROJECT NUMBER
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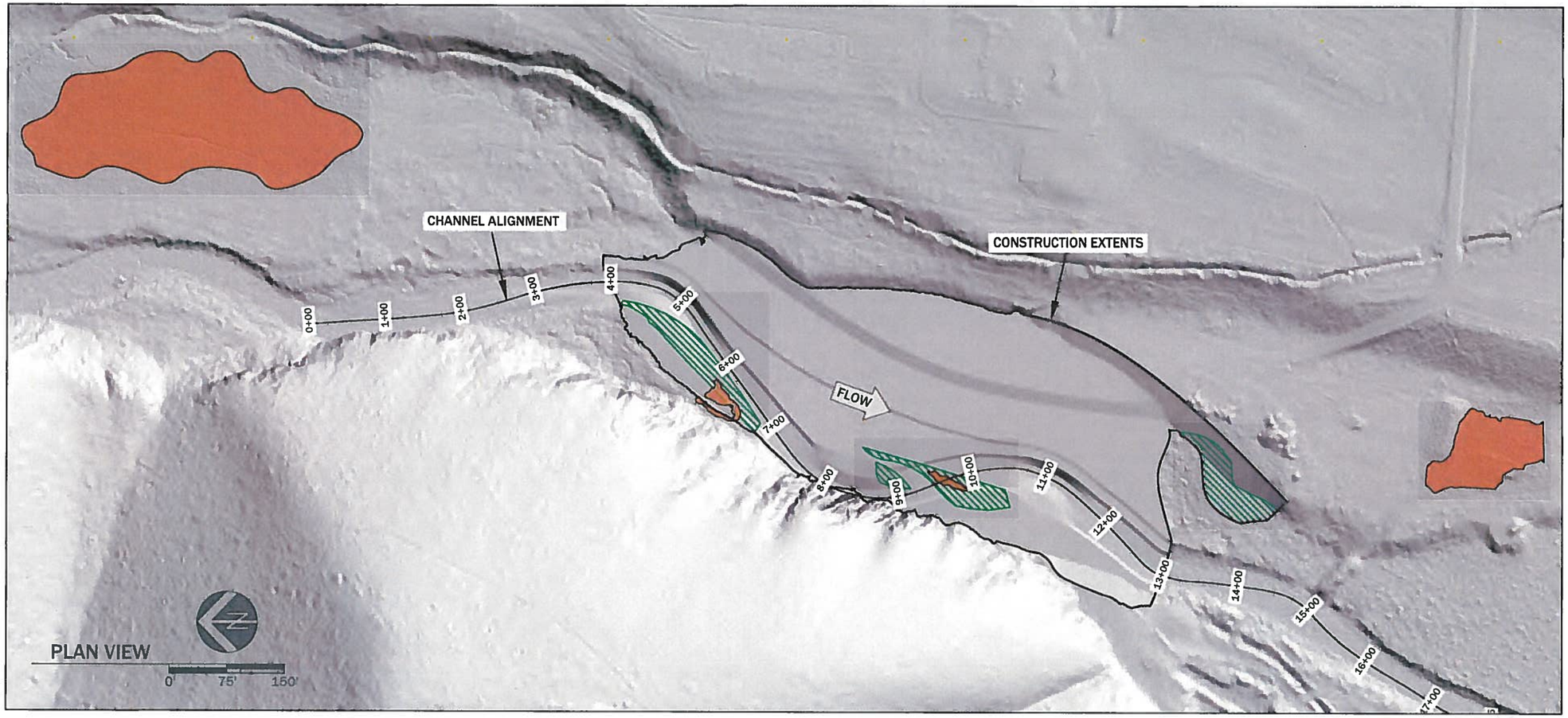
SHEET NUMBER



LEGEND

- VEGETATIVE SALVAGE AREA
- WEED MANAGEMENT AREA

NOTE: WHERE SPECIES THAT ARE SUITABLE FOR TRANSPLANT SUCH AS WILLOWS, RED-OSIER DOGWOOD, OR OTHERS OCCUR, ATTEMPTS WILL BE MADE TO SALVAGE AND TRANSPLANT IF THE PLANTS CAN BE REMOVED WITHOUT DAMAGE AND IF SUITABLE TRANSPLANT SITES ARE AVAILABLE FOR THEIR PLACEMENT. SALVAGED PLANTS WILL BE TRANSPLANTED TO LOCATIONS SPECIFIED BY THE ENGINEER ON SITE. THESE LOCATIONS WILL BE IN BETWEEN PLANTING EXCLOSURES.

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VEGETATION SALVAGE AND WEED MANAGEMENT PLAN

NO.	DATE	BY	DESCRIPTION	CHK

PROJECT NUMBER
RDG-18-065

SHEET NUMBER

4 Example Restoration Treatments

4.1 Example Revegetation and Floodplain Treatments

4.1.1 Weed Management

Pre-project weed management is recommended to target existing noxious weed infestations within construction limits including the staging area and access routes. Pre-project weed management techniques will generally include targeted herbicide application, avoiding native species. Weed mowing may occur prior to herbicide application where dense patches of weeds occur. Locations and species to target will be identified in the field during 2018 and all weed control work should be completed by a licensed herbicide applicator.

4.1.2 Preservation and Salvage

Existing, native riparian and wetland vegetation communities in the project area will be preserved to the greatest extent possible. Where preservation of desired native species is not feasible attempts will be made to salvage and directly transplanted vegetation into constructed streambank structures or constructed floodplain features.

4.1.3 Containerized Planting

Containerized plants are used to establish riparian tree and shrub communities within the restored floodplain and along streambanks of Rattlesnake Creek. The desired vegetation community in the project area includes a Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland, dominated by black cottonwood, conifers, red-osier dogwood, willows, and other native species common to the project area and reference vegetation communities in the vicinity. Other vegetation communities can include Ponderosa Pine woodlands, and various marsh and wetland ecosystem types.

Tree and shrub species planned for installation in distinct planting zones will be identified in the design phase of the Rattlesnake Creek Dam Mitigation Study. Actual species and quantities of each species will be based on availability at the time of the plant order for the project. Plant material will consist of trees and shrubs grown in one- to three-gallon size containers. Portions of the floodplain zone will be left unplanted to allow opportunities for natural colonization of riparian species such as cottonwoods and willows.

Installed plants will require additional treatments to address weed competition that may negatively affect their survival. Brush blankets will be placed at the base of each plant to reduce competition from weeds and/or grasses. Brush blankets are thin squares of synthetic fabric or matting that block light and prevent growth of vegetation around the base of the planted tree or shrub, but allow water to percolate through. A weed management program will manage regrowth of noxious or invasive weeds within the planting area.

Floodplain roughness consists of microtopography grading and buried wood placement on newly constructed floodplain surfaces. Microtopography is grading that results in small furrows and ridges varying in elevation. This treatment creates complexity and microsites on newly constructed floodplain surfaces to trap and protect seed and other plant propagules, and to provide resistance to erosion by limiting rill formation. The woody debris increases soil moisture retention, creates protective microsites for establishing seed and plants, and promotes soil development by introducing organic material. Floodplain roughness can discourage browse pressure by making access to planted material or naturally colonizing trees and shrubs more difficult.

4.1.4 Floodplain Roughness

Floodplain roughness will be incorporated into all constructed floodplain and slope surfaces to limit surface erosion and to support revegetation efforts. Floodplain roughness is created using equipment to roughen the constructed surface with microtopography and partially bury woody debris in the soil. Microtopography creates variation in the constructed floodplain surface ranging from 0.5 feet above to 0.5 feet below the design floodplain surface. Wood placement for roughness will include partially buried small logs and brush. Figure 4-1 provides examples of floodplain roughness treatments.

Figure 4-1. Examples of floodplain roughness treatments and cottonwood recruitment one year after construction (left) and four years after construction (right) on the Kootenai River near Bonners Ferry, Idaho.

4.1.5 Fencing and Browse Protection

Wildlife may preferentially browse the shoots of newly planted material and browse protection is needed to support the establishment of the plants and the development of a self-sustaining plant community. Wildlife browse will be managed through the use of riparian browse exclosure fencing and individual browse protectors. Discrete exclosure fencing units will be located along the channel to support vegetation establishment in key locations while facilitating movement of wildlife species through the project area. Individual browse protectors will be used in areas not protected by exclosure fencing.

4.1.6 Seeding and Reclamation

Restoration seeding will occur within constructed floodplain surfaces. Restoration seeding will utilize hydroseeding methods that incorporate hand broadcast seed application followed by application of a mulch and tackifier via a pneumatic blower.

Reclamation seeding will occur within reclaimed access routes and staging areas, outside of the restoration treatment extents. Drill seeding is the preferred method for seeding construction disturbance areas where slopes are less steep than 4:1. Drill seeding application methods utilize a seed drill to place seed in the ground resulting in better protection and seed to soil contact. Where disturbance extents overlap with agricultural fields or pasture, the seed mix will be developed in coordination with landowners to meet their needs.

4.2 Example Streambank and Streambed Treatments

Streambank structures are constructed on the channel margins to establish vegetation, enhance aquatic habitat and improve bank stability. Depending on the application, streambank structures may be localized installations or contiguous reach-scale treatments. Streambank structures used for restoration may be deformable whereby the structures serve a temporary function to provide stable conditions for the

growth and establishment of vegetation. Streambank structures used for bank stability may be more permanent in order to manage risk by protecting infrastructure or preventing channel migration. Potential streambank treatments for the project site may include:

- Bioengineering;
- Vegetated brush banks; and
- Engineered log jams.

In addition to streambank treatments, streambed treatments are constructed on the channel bed to provide vertical stability, create roughness and enhance aquatic habitat. Potential streambed treatments for the project site may include:

- Riffles;
- Boulder clusters; and
- Large wood.

4.2.1 Bioengineering

Bioengineering is a category of streambank treatments consisting of live plant material and soil wrapped in biodegradable coconut fiber fabrics (coir). Bioengineering treatments create bank conditions that support the establishment of woody vegetation. The structure is built by stacking layers of soil wraps on an alluvial rock foundation to form a revetment. The coir fabric includes an outer coir fabric for strength/abrasion resistance and an inner mesh fabric that prevents the inner soil from piping out of the wraps. Vegetative cuttings are placed between the layers to establish streambank vegetation. Figure 4-2 shows a conceptual cross section view of a typical bioengineering streambank treatment called a vegetated soil lift. Figure 4-3 shows photographs of constructed vegetated soil lift structures on the Clark Fork River in Montana.

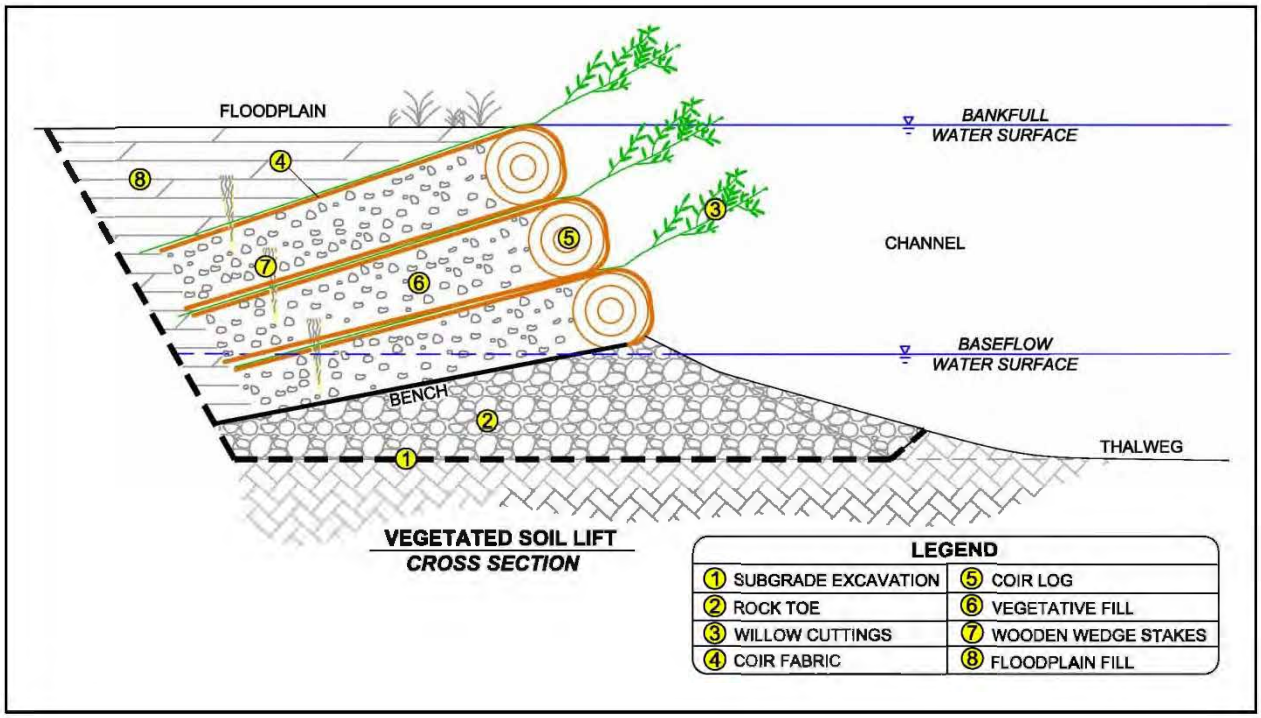

Figure 4-2. Conceptual cross section of a vegetated soil lift bioengineering streambank structure.

Figure 4-3. Example of vegetated soil lifts on the Clark Fork River in Montana following construction (left) and after three years of growth (right).

4.2.2 Vegetated Brush Banks

Vegetated brush bank structures consist of stacked layers of brush and small logs built on an alluvial rock foundation. Vegetative cuttings are placed within the brush layers at elevations that are in contact with the water table during the growing season. The structure is backfilled with gravel and soil to fill the voids and provide growth media for the cuttings. The brush provides bank cover for aquatic habitat and roughness for dissipating flow and wave energy. The brush can also function as a browse deterrent by making access to bank vegetation difficult. Over time, the brush will decompose, and woody vegetation will become established along the streambank. Figure 4-4 displays photographs of vegetated brush bank structures on Ninemile Creek near Huson, Montana.

Figure 4-4. Example of constructed vegetated brush bank structures on Ninemile Creek near Huson, Montana after one year of growth (left) and after three years of growth (right).

4.2.3 Engineered Log Jams

Engineered log jams provide several benefits that improve river dynamics and enhance aquatic habitat (Bureau of Reclamation and U.S. Army Engineer Research and Development Center 2016). Engineered log jams create hydraulic conditions that maintain small pools, provide small recirculation zones (eddies) that offer hydraulic complexity to focal aquatic species, and protect adjacent bank areas from erosion. Engineered log jams also can establish roughness elements that recruit available wood and gravel. Engineered log jam structures consist of multiple tiers of stacked large logs with attached rootfans. Smaller wood and brush is wood racked between the large logs. The structure is backfilled with soil or rock to counteract buoyancy and sliding forces. Figure 4-5 shows a conceptual cross section view of an

engineered log jam structure. Figure 4-6 displays examples of engineered log jam structures on regional river systems.

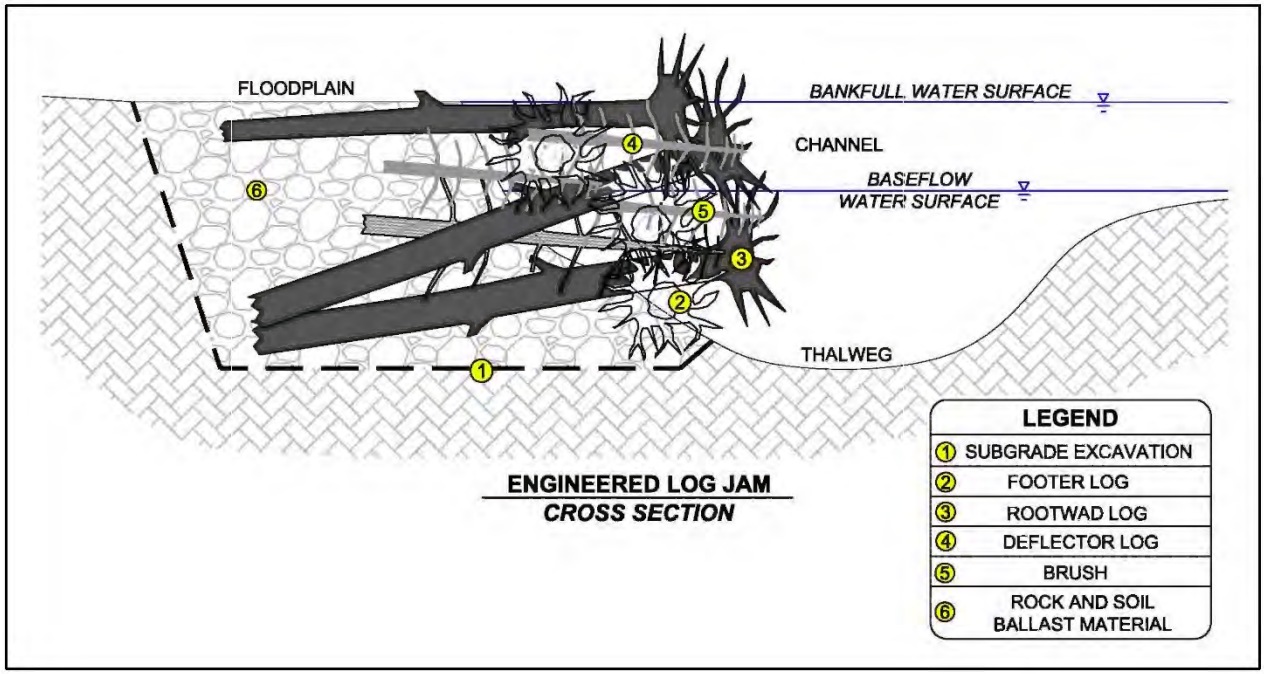

Figure 4-5. Conceptual cross section of an engineered log jam.

Figure 4-6. Examples of engineered log jams on a Kootenai River side channel near Bonners Ferry, Idaho (left) and the Jocko River near Arlee, Montana (right).

4.2.4 Riffles

Channel reconstruction will include riffle construction to provide vertical stability and transitions between pools and/or meander bends. A well-graded mix of alluvial substrates is used to replicate natural bed materials and allow natural sorting processes to develop pavement and sub-pavement layers. A matrix of boulders will be used to provide vertical bed stability and maintain interstitial spaces. A conceptual riffle substrate composition is illustrated in Figure 4-7.

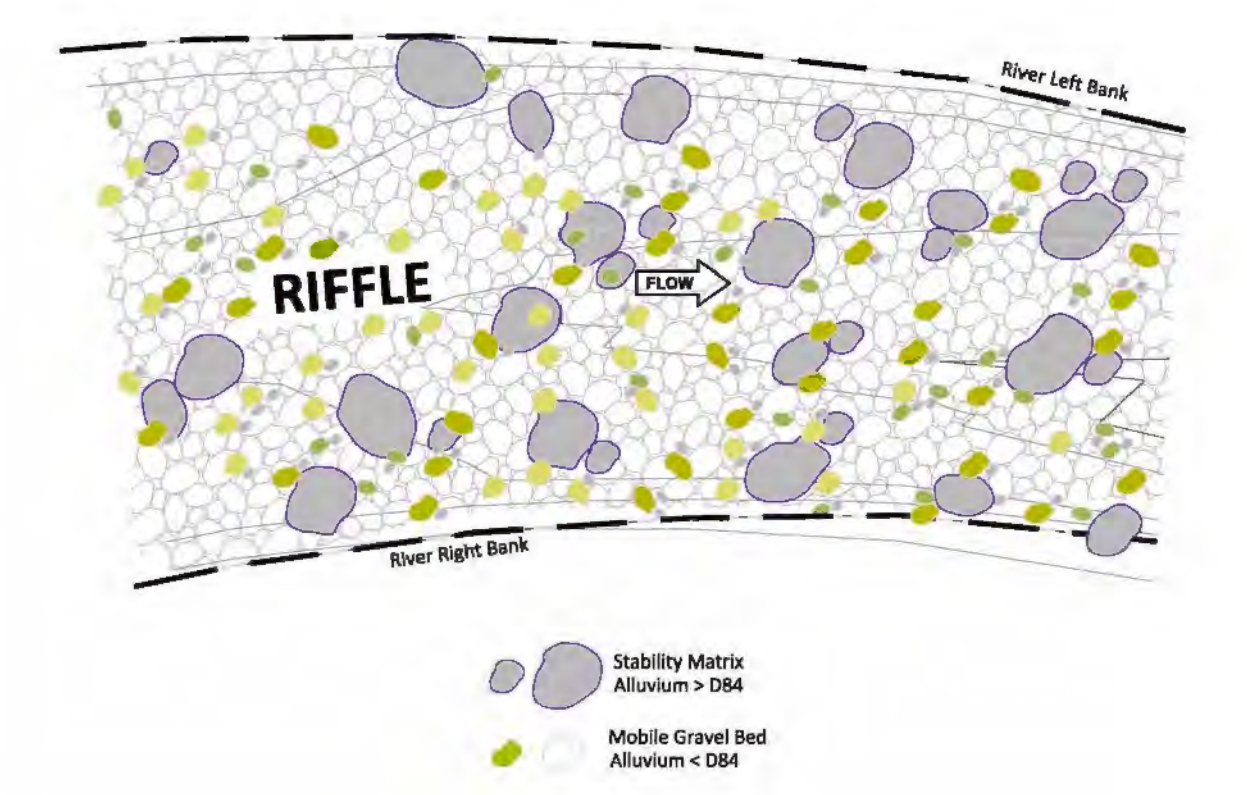

Figure 4-7. Conceptual riffle construction detail illustrating the well-graded mix of alluvial substrates comprised of mobile gravels and a larger stability matrix.

4.2.5 Boulder Clusters and Large Wood

Boulder clusters and large wood enhance aquatic habitat by creating hydraulic complexity, establishing cover, providing substrate diversity and promoting small pool development. Structures are typically constructed from native materials including whole trees alluvial boulders. Example treatments are shown in Figure 4-8.

Figure 4-8. Example of a natural boulder cluster on Rattlesnake Creek (left) and large wood habitat enhancement (right) on South Fork Coal Creek near Polebridge, Montana (right).

4.3 Off-Channel Habitat Features

Incorporating off-channel habitat features into floodplains is a restoration strategy that promotes habitat complexity and diversity. There are three main types of off-channel habitat features recommended for the project area – side channels, wetlands and alcoves.

4.3.1 Side Channels

Side channels are small perennial or intermittent channels that branch off the main channel and flow across the floodplain. Side channels typically exhibit lower velocities and depths than the main channel thus providing diverse types of habitat including juvenile rearing, spawning for adults and high flow refugia for other aquatic species. In addition, side channels exchange water, sediment and nutrients between the main channel and off-channel areas thus supporting diverse vegetation communities.

4.3.2 Wetlands and Beaver Dam Analogs

Wetlands are depressional or low-lying features with standing water or saturated soils for a portion of the growing season sufficient to support wetland vegetation such as willows, sedges and rushes. Wetlands provide a wide range of ecological functions such as water quality improvement, sediment storage and habitat for both terrestrial and aquatic organisms. Wetlands may be incorporated into side channels or enhanced using Beaver Dam Analogs (BDAs). BDAs are structures resembling beaver dams and are built from brush, soil and vegetation. BDAs may provide the function of natural beaver dams by impounding water and expanding wetlands, or BDAs may attract beavers that maintain and expand the constructed BDAs.

Figure 4-9. Examples of a Beaver Dam Analog on the floodplain of Lolo Creek near Pierce, Idaho (left), and a natural Beaver Dam on Ninemile Creek near Huson, Montana (right).

4.3.3 Alcoves

Alcoves are shallow backwater features adjacent to the main channel. Alcoves provide shallow depths, low velocities, warmer water and fine substrate that support macroinvertebrate production and juvenile rearing. Alcoves are typically deep enough to maintain water year-round but may vary in dynamic fluvial environments.